In Situ Investigations on Chemical and Electrochemical Dissolution of Oxide Films on Ti and Ti Alloys

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Ti and its alloys (e.g., TiAlV, TiAlNb) are widely used in biomedical applications (e.g., implants), due to their excellent reputation for corrosion resistance and biocompatibility. However, specific problems connected to chemical and mechanical stability of the implants can still be encountered with these materials, which have been mostly attributed to the conjoint action of chemical and mechanical attack, so-called fretting corrosion (1-9). Even though generally it is assumed that fretting corrosion is responsible for most of the metal release into tissue (10-11), also in the case of stable passivity without additional mechanical attack, some release of metal ions due to passive dissolution can take place.

Despite the high general corrosion resistance of Ti, increasing evidence is found that titanium is released into and accumulated in tissue adjacent to titanium implants (12-14). Even though generally considered as highly biocompatible, it has been observed that the tissue reaction to released Ti species can vary from a mild response to a more severe one. Since the reaction can vary depending on the chemical nature of the released metal particles, mechanistic information on the metal release modes - resulting in a knowledge on the chemistry and quantity of metal released - is required to predict the behavior in the biological environment.

Dissolution of anodic oxide films on Ti has been investigated at open-circuit potential or under cathodic polarization, but only in few selective solutions (15-17). Generally for Ti and especially for Ti alloys, mechanistic knowledge on the chemical and electrochemical stability of native passive films or of anodic oxide films is scarce.

The present investigation contributes to this lack of knowledge, by starting up a study on critical factors influencing the chemical and electrochemical dissolution of titanium and its alloys in different environments.

Dissolution behavior of anodic oxide films on Ti and Ti alloys is being studied with a differential light reflection technique (using a HeCd LASER), which allows fast *in situ* studies of the oxide film formation and dissolution on surfaces (18). Parameters of interest are the material (cp-Ti vs. TiAlV, TiAlNb), type of oxide film present on the surface (native passive film vs. anodic oxide films), electrochemical conditions of dissolution (open-circuit dissolution vs. cathodic polarization), and solution chemistry (e.g., pH, specific action of halide ions, effect of complexing species).

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